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Compound and method to improve wrinkle resistance in fabrics, and device for containing such a compound

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Compound and method to improve wrinkle resistance in fabrics, and device for containing such a compound

The invention relates to a compound to improve wrinkle resistance in fabrics, comprising: a wrinkle reducing active, comprising at least one softening agent, and a liquid carrier for carrying the active. The invention also relates to a wrinkle reducing active as used in such a compound. The invention further relates to a device for containing such a compound. Moreover, the invention relates to a method for improving wrinkle resistance in a fabric by use of such a compound.

In terms of a long-lasting ironing result, wrinkle resistance is the property of an ironed garment to resist the formation of wrinkles in the long-term, id est during wear or during storage. Wrinkle resistance in a fabric is a result of either a better recovery from a wrinkling deformation, or a higher resistance to wrinkle formation, id est the need for a higher force to induce the wrinkles. In general, wrinkles are formed due to two effects: (i) viscoelastic relaxation in the individual fibres, and (ii) inter-fibre and/or inter-yarn friction. With respect to the first issue (i) it is known that when a fabric is creased, e.g. bent to form a wrinkle either during wear, during the laundry cycle, or during storage, individual fibres lose potential energy due to stress relaxation. This stress relaxation is on account of the fact that energy is dissipated in the fibres by the continuous breaking and reformation of secondary (hydrogen) bonds. This process is accelerated by the transport of moisture in and out of the fibres (e.g. during wear or during the laundry cycle). This results in a reduction of the driving force for recovery. With respect to the second issue (ii) it is known that when a creased fabric is released, the residual energy in the fibres induces the fabric to recover a part of the deformation. However, frictional forces between the fibres and yarns can restrict this recovery to some extent.

In order to induce wrinkle resistance in a fabric industrially, two main approaches are used, based on the two aforementioned effects leading to wrinkle formation. In order to suppress viscoelastic relaxation in the individual fibres, the individual fibres can be chemically crosslinked, thereby stabilising the molecular network within. In order to overcome friction during recovery, fabrics are treated with softeners, which reduce the friction by forming a thin layer of lubricating material around the fibres. Another option to

reduce the friction is by using crosslinked elastic film-forming materials that replace frictional contacts between fibres with elastic junctions, which provide an additional source of energy during recovery. Quite often, a combination of both concepts (chemical crosslinking and reduction of inter-fibre friction) is used to induce the optimum wrinkle resistance for a given system.

The use of fabric softeners is a well-known technology to reduce the formation of wrinkles, or to impart a degree of wrinkle resistance, in fabrics. However, the use of certain softeners can lead to a significantly lower fabric stiffness compared to the reference fabric. This results in the treated fabric sometimes being subjected to greater wrinkling deformations during wear, which leads to more severe wrinkling compared to the reference fabric. However, under the same wrinkling deformation (e.g. in certain objective wrinkling tests), the treated fabric shows a better recovery than the reference fabric, id est less wrinkling. To obtain a balance between these two situations, it is desirable to have a softener that is capable of reducing friction during recovery, but maintaining the stiffness of the fabric within a certain range compared to the stiffness of a reference fabric.

It is an object of the invention to provide a compound to improve wrinkle resistance in fabrics with which a relatively good recovery of the fabric can be obtained, while a relatively good stiffness will be maintained.

This object can be achieved by a compound according to the preamble characterizing in that the wrinkle reducing active further comprises at least one crosslinking agent for crosslinking said softening agent substantially at increased temperature. By controlled crosslinking of the softening agent the compound will not only show a satisfying wrinkle recovery of a fabric, but will also improve the stiffness of this fabric. Factually, the crosslinks present between the yarns and fibers of the fabric result in an increased stiffness. Thus, by controlled crosslinking of the softening agent a good balance can be obtained between the stiffness and the wrinkle recovery of the fabric. During controlled crosslinking the active can become an advantageous viscoelastic substance, with which said balance can be obtained. This viscoelastic material has both a measurable viscosity and a measurable elasticity. Viscosity will normally lie in the range of 10 - 1000 Pas, whereas the dynamic storage modulus (G') will commonly lie in the range of 0.01 - 0.1 MPa (measured at a frequency of 1 Hz). Preferably, the viscosity is about 200 Pas, and the dynamic storage modulus will be about 0.05 MPa. After application of the compound according to the invention onto a fabric wrinkling of the fabric will occur less easily, while its wrinkle recovery remains at the conventional advantageous level. A highly crosslinked compound

would rather lead to an elastomeric coating than to a softening agent. The crosslinking process of the softening agent commonly also occurs at room temperature (circa 20 degrees Celsius), but this process is normally – dependent on the concentration of the wrinkle reducing active in the liquid carrier – relatively slowly. At an increased temperature compared to the environmental (room) temperature, preferably between 50 and 100 degrees Celsius, the speed of this crosslinking process will be increased significantly, so that, e.g. during ironing, a fabric can easily be provided with at least a partially crosslinked softening agent. Noted is that the liquid carrier will commonly substantially consist of water and/or ethanol.

In a preferred embodiment every molecule of the softening agent has multiple hydroxyl and/or amino groups. These groups could e.g. be formed by end groups or could be part of side chains of the molecules. With these kinds of reactive groups crosslinking can be established by using organically modified polyalkoxy silanes. In this way the crosslinking process can be completed relatively quickly, wherein the extent of crosslinking of the softening agent can be controlled relatively well.

Preferably, the softening agent is a silicon based softening agent. A (curable) silicon based softening agent, like e.g. PolyDiMethylSiloxane (PDMS), is commonly very suitable to apply as softening agent due to its relatively low(-)viscosity and lubricating properties (hence possessing a low shear stress), commonly resulting – in applied condition – in a low resistance to deformation between the fibres or yarns. Both hydroxy-terminated (modified) silicones and amino-terminated (modified) silicones can be applied as softening agent in the compound according to the invention due to their strong interaction with the fibre surface.

In another preferred embodiment the crosslinking agent comprises at least one organically modified polyalkoxy silane. By using a silane based crosslinking agent in combination with the silicon based softening agent a relatively controlled crosslinking of the softening agent can be achieved. Moreover, the crosslinking process takes place substantially within the timescale (and other boundary conditions) of ironing. More preferably, an alkyl trialkoxy silane is used as crosslinking agent. Examples of silanes suitable to act as crosslinking agent are: Alkyl Trialkoxy silanes like Methyl Tri-Methoxy Silane (MTMS) and glycidyl-based silanes, like glycidoxypropyl trimethoxy silane.

In a preferred embodiment the compound further comprises at least one catalyst for crosslinking the softening agent. By using one or more catalysts the crosslinking reaction between the softening agent and the crosslinking agent can be speeded up to

establish completion of the crosslinking process within the timescale of e.g. ironing. Examples of suitable catalysts for this purpose are: aluminium based salts, aluminium alkoxydes, and Methyl Aluminium Phosphate (MAP).

In another preferred embodiment the content of the active in the liquid carrier is between 2 and 20 weight percent. Between these values a good dispersion of the active in the liquid carrier can be obtained and conserved. In the range of 1 and 40, preferably between 2 and 20, more preferably between 5 and 10 weight percent, the concentration of the active in the liquid carrier is such that the crosslinking reaction between the softening agent and the crosslinking agent will not, or will significantly not, be initiated at normal atmospheric temperature (room temperature). Preferably, the crosslinking agent content in the active is between 0,5 and 10 weight percent, preferably 5 weight percent. More preferably, the crosslinking agent content in the active is set dependent on the amount of reactive groups in the softening agent. With such a relative quantity the desired crosslinking of the softening agent can be achieved. This crosslinking will then be sufficient to increase the stiffness of the fabric – whereon the compound is applied to – to a desired level, while substantially maintaining the relatively high wrinkle recovery capacity. Further increasing the amount of crosslinking agent in the active will commonly lead to an over-crosslinked softening agent (too high crosslinking density), which has rather elastomeric properties than softening properties. Consequently, this would result in a too high fabric stiffness.

The compound according to the invention is preferably provided with additives, such as surfactants, fragrances, anti-bacterial additives, et cetera, as long as the additive does not interfere with the primary function of the silicone softener. The use of additives in a compound according to the invention can be very suitable when applying the compound on a fabric by means of a domestic appliance, such as a washing machine or an iron.

The invention also relates to a wrinkle reducing active as used in said compound.

The invention further relates to a device for containing such a compound, comprising at least one container for containing at least a part of said compound, wherein said container is provided with at least one outlet for applying said compound onto a fabric. Examples of such a device are: an iron, a spray bottle (for application of the compound onto the fabric prior to ironing), a washing machine, et cetera. Preferably, the device is formed by a removable cartridge for an iron. In this cartridge the wrinkle reducing active is commonly contained in concentrated condition. During application of this active onto the fabric the

active is diluted with water, preferably with water contained in a separate water container of the iron, to a desired active concentration. For example, the outlet can be formed by a nozzle. Preferably, the device comprises a first container for the at least one softening agent dispersed in a first liquid carrier, and a second container for the at least one crosslinking agent dispersed in a second liquid carrier. By separating the most essential ingredients of the compound according to the invention initiation of the crosslinking reaction as described above can be prevented and be postponed. During the application of the two emulsions onto the fabric these ingredients will be brought into mutual contact resulting in an initiation of the crosslinking reaction. As already mentioned before this reaction will normally be accelerated significantly by increasing the surrounding temperature, e.g. by means of an iron. Since the crosslinking reaction will be accelerated commonly by increasing the temperature of the compound, it is not always necessary to separate the two basic ingredients within the device, as long as the temperature of this device, and more particular the container of the device carrying this compound, is not increased (significantly).

Moreover, the invention relates to a method for improving wrinkle resistance in a fabric by use of such a compound, comprising the steps of: A) applying the compound onto the fabric, B) removing the wrinkles in the fabric, C) permitting the liquid carrier to evaporate at least partially, and D) crosslinking the softening agent to some extent by increasing the temperature of the fabric. Step C) and step D) are generally applied at the same time. An amount of active typically applied, particularly sprayed, onto the fabric is preferably from about 0,5 to about 10 weight percent, more preferably from about 2 to about 5 weight percent of the conditioned weight of the fabric. Once an effective amount of compound is sprayed onto the fabric, the fabric is stretched or smoothed by hand according to step B). After the effective amount of compound is applied to the fabric and preferably stretched, the liquid, in particular moisture, is permitted to evaporate at least substantially. If step C) and D) are applied at the same time, evaporation will occur in an active, forced way by increase in temperature of the fabric. During this temperature increase the reaction between the softening agent and the crosslinking agent will de facto be initiated. During this temporarily increased temperature crosslinking to some, but sufficient, extent of the softening agent will be established. The evaporation of moisture during the application of an increased temperature will commonly result in stress relaxation in the fibres of the fabric. A decrease in the stored energy will maintain the fabric in its set, id est flat, state.

Preferably, the application of the compound onto the fabric according to step A) is realised by means of a domestic appliance. Examples of such domestic appliances are a

washing machine, an iron provided with a compound spraying reservoir, and other spraying devices for a compound according to the invention.

In a preferred embodiment of the invention the removal of the wrinkles in the fabric according to step B) is realised by means of an iron at an increased temperature compared to an environmental temperature (room temperature). In this way step C) and D) will commonly be applied during application of step B). Thus, the increased temperature will lead both to an accelerated evaporation of applied liquid and to crosslinking of the softening agent. Cooling down of the fabric results commonly in a protective layer formed around the stretched yarns of the fabric. It must be clear that the steps A)-D) need not to be applied subsequently, but can be applied at the same time.

In yet another preferred embodiment the softening agent and the crosslinking agent are applied onto the fabric separately during application of step A). As aforementioned it may be advantageous to apply the main ingredients of the compound according to the invention, id est the softening agent and the crosslinking agent (thereby disregarding the liquid carrier), separately in order to prevent premature initiation of the crosslinking reaction.

The invention can further be illustrated by way of the following non-limiting example.

Example 1

A commercial fabric softener called Tinotex CMA (supplied by Ciba) was obtained as a 40% emulsion (by weight). Methyl Tri Methoxy Silane (MTMS) was supplied by Aldrich and used as received. MTMS was first hydrolysed as follows: 25 g of MTMS was mixed with 0.35 g (1/60 Molar equivalents) of maleic acid and 200 g of ethanol, by stirring well. To this was added, dropwise, 15 g of deionised water. The reaction was allowed to proceed to completion in 15 minutes. The Tinotex CMA was diluted with water till an 8% emulsion (by weight) was obtained. To this was added 3% (by weight of pure compound based on the Tinotex CMA) of the hydrolysed MTMS (corrected for the concentration of the hydrolysed MTMS in solution).

This emulsion was sprayed on the cotton samples to be tested (wet pick-up of about 33% of the conditioned weight of the fabric). The samples were ironed to dryness after they were allowed to dry in air till a wet-pick up of about 20% was attained. Hence, a solid pick-up of 2.7% is obtained. After ironing, the samples were conditioned for at least 24 hours. The samples were then subjected to the AATCC method 128 (Wrinkle Tester Method). This test method is used to determine the wrinkle recovery of woven fabrics.

During this test the samples are wrinkled and compressed under controlled conditions of time (5 minutes) and force (weight of the upper flange, no additional load) to create a wrinkled fabric. The samples are then suspended under conditions of controlled temperature and humidity (21°C, 60% RH) for a controlled recovery period (24 hours), after which the fabric is assessed in comparison with the AATCC replicas. For sakes of comparison, fabrics were treated in a similar way either with water or with just Tinotex CMA (solid pick-up: 2.7%). The results are demonstrated in the following table.

Treatment	AATCC score
Reference (water)	2.3
Tinotex CMA	2.2
Tinotex CMA + 3% MTMS	2.9

In this table the results are indicated by way of an AATCC score from 1 to 5, wherein the lowest AATCC score of 1 complies with a very poor appearance and the highest AATCC score of 5 complies with the best appearance.

CLAIMS:

1. Compound to improve wrinkle resistance in fabrics, comprising:
- a wrinkle reducing active, comprising at least one softening agent, and
- at least one liquid carrier for carrying the active,
characterizing in that the wrinkle reducing active further comprises at least one crosslinking agent for crosslinking said softening agent substantially at increased temperature.

2. Compound according to claim 1, characterizing in that every molecule of the softening agent has multiple hydroxyl and/or amino groups.

3. Compound according to claim 2, characterizing in that the softening agent is a silicon based softening agent.

4. Compound according to one of the foregoing claims, characterizing in that the crosslinking agent comprises at least one organically modified polyalkoxy silane.

5. Compound according to one of the foregoing claims, characterizing in that the compound further comprises at least one catalyst for crosslinking the softening agent.

6. Compound according to one of the foregoing claims, characterizing in that the content of the active in the liquid carrier is between 2 and 20 weight percent.

7. Compound according to one of the foregoing claims, characterizing in that the crosslinking agent content in the active is dependent on the amount of reactive groups in the softening agent.

8. Compound according to one of the foregoing claims, characterizing in that the compound is provided with additives, preferably a surfactant, a fragrance and a preservative.

9. Wrinkle reducing active as used in a compound according to one of the foregoing claims 1-8.

10. Device for containing a compound according to one of the claims 1-8, comprising at least one container for containing at least a part of said compound, wherein said container is provided with at least one outlet for applying said compound onto a fabric.

11. Device according to claim 10, characterizing in that the device comprises a first container for the at least one softening agent dispersed in a first liquid carrier, and a second container for the at least one crosslinking agent dispersed in a second liquid carrier.

12. Device according to claim 10 or 11, characterizing in that the device is adapted to be removably coupled to an iron.

13. Method for improving wrinkle resistance in a fabric by use of a compound according to one of the foregoing claims 1-8, comprising the steps of:

A) applying the compound onto the fabric,

B) removing the wrinkles in the fabric,

C) permitting the liquid carrier to evaporate at least partially, and

D) crosslinking the softening agent by increasing the temperature of the fabric.

14. Method according to claim 13, characterizing in that the application of the compound onto the fabric according to step A) is realised by means of a domestic appliance.

15. Method according to claim 13 or 14, characterizing in that the removal of the wrinkles in the fabric according to step B) is realised by means of an iron at an increased temperature compared to room temperature.

16. Method according to one of the foregoing claims 13-15, characterizing in that step C) is applied during application of step B).

17. Method according to one claims 13-16, characterizing in that during application of step A) the softening agent and the crosslinking agent are applied onto the fabric separately.

ABSTRACT:

The invention relates to a compound to improve wrinkle resistance in fabrics, comprising: a wrinkle reducing active, comprising at least one softening agent, and a liquid carrier for carrying the active. The invention also relates to a wrinkle reducing active as used in such a compound. The invention further relates to a device for containing such a compound. Moreover, the invention relates to a method for improving wrinkle resistance in a fabric by use of such a compound.